



C o/c

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

U.S. Patent No.: 6,801,148 B2

Issued: October 5, 2004

Application Serial No.: 09/760,531

Filed: 01/16/2001

Inventor: Freeman, et al.

Atty. Docket No.: 1692-81437

Title: BEAMFORMED ULTRASONIC IMAGER WITH  
DELTA-SIGMA FEEDBACK CONTROL

REQUEST FOR CERTIFICATE OF CORRECTION UNDER 37 C.F.R. §1.322(a)

Certificate of Correction Branch  
PO Box 1450  
Alexandria, VA 22313-1450

Certificate  
JUL 11 2005  
of Correction

Sir:

Enclosed herewith is a Certificate of Correction in connection with the above-identified patent. The Assignee of record is incorrect on the letters patent. The enclosed marked up version of the first page of the patent is enclosed herewith. The Assignee should be changed from "The Regents of the University of Michigan, Ann Arbor, MI (US)" to "The Regents of the University of Michigan, Ann Arbor, MI (US); Q-Dot, Inc., Colorado Springs, CO (US)". Copies of the first pages of two of the parent applications (U.S. Patent No. 6,208,189 and 5,964,708) are enclosed noting the correct assignee information to be The Regents of the University of Michigan, Ann Arbor, MI (US); Q-Dot, Inc., Colorado Springs, CO (US).

Applicant respectfully requests entry in the patent file and requests that a Certificate of Correction issue identifying the same.

It is believed that the error to be corrected resulted from an error on the part of the U.S. Patent and Trademark Office.

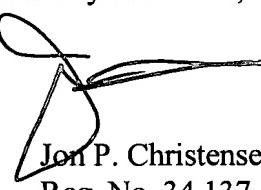
No fee is believed necessary. However, should any fee be needed, the Commissioner is hereby authorized to charge any underpayment or credit any overpayment to Deposit Account No. 23-0920. A duplicate copy of this sheet is enclosed.

JUL 12 2005

U.S. Patent No. 6,801,148 *B2*  
Issued: October 5, 2004  
Mailed: June 28, 2005

Should there be any questions or concerns, it is respectfully requested that the undersigned be contacted.

Respectfully submitted,

By:   
Jon P. Christensen  
Reg. No. 34,137

June 28, 2005  
Welsh & Katz, Ltd.  
120 S. Riverside Plaza, 22<sup>nd</sup> Floor  
Chicago, IL 60606-3912  
(312) 655-1500 Telephone  
(312) 655-1501 Facsimile

Enclosures:

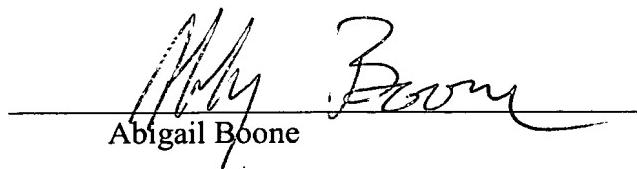
Certificate of Correction

Marked-up version of the first page of the patent

Copies of the first pages of parent applications (U.S. Patent No. 6,208,189 and 5,964,708)

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

I hereby certify that this Communication is being deposited with the United States Postal Service with sufficient postage as First Class Mail in an envelope addressed to Certificate of Correction Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-0001, on May 4, 2004.

  
Abigail Boone

June 28, 2005

**UNITED STATES PATENT AND TRADEMARK OFFICE**  
**CERTIFICATE OF CORRECTION**

PATENT NO : 6,801,148 *B2*

DATED : October 5, 2004

INVENTOR(S) : Freeman et al.

It is certified that error appears in the above-identified patent and that said Letters Patent  
is hereby corrected as shown below:

(73) Assignee: The Regents of the University of Michigan, Ann Arbor, MI (US); Q-Dot, Inc., Colorado Springs, CO (US)

MAILING ADDRESS OF SENDER: Jon P. Christensen

Reg. No. 34,137

Welsh & Katz, Ltd.

120 S. Riverside Plaza, 22nd Floor

Chicago, IL 60606-3912

PATENT NO. 6,801,148 *B2*

No. of additional copies



Oct 2 2005



US006801148B2

(12) **United States Patent**  
Freeman et al.

(10) **Patent No.:** US 6,801,148 B2  
(45) **Date of Patent:** Oct. 5, 2004

(54) **BEAMFORMED ULTRASONIC IMAGER WITH DELTA-SIGMA FEEDBACK CONTROL**

(75) Inventors: Steven R. Freeman, Ann Arbor, MI (US); Matthew O'Donnell, Ann Arbor, MI (US); Thomas E. Linnenbrink, Monument, CO (US); Marc A. Morin, Woodland Park, CO (US); Marshall K. Quick, Colorado Springs, CO (US); Charles S. Desilets, Edmonds, WA (US)

(73) Assignee: The Regents of the University of Michigan, Ann Arbor, MI (US); Q-Dot, Inc., Colorado Springs, CO (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 809 days.

(21) Appl. No.: 09/760,531

(22) Filed: Jan. 16, 2001

(65) **Prior Publication Data**

US 2003/0231125 A1 Dec. 18, 2003

**Related U.S. Application Data**

(62) Division of application No. 09/358,039, filed on Jul. 20, 1999, now Pat. No. 6,208,189, which is a division of application No. 08/944,226, filed on Oct. 6, 1997, now Pat. No. 5,964,708.

(51) Int. Cl.<sup>7</sup> ..... H03M 3/00

(52) U.S. Cl. .... 341/143; 341/172; 341/144; 341/155; 600/447

(58) **Field of Search** ..... 341/143, 172, 341/144, 155; 600/447

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

3,946,320 A	3/1976	Overbury	.....	325/470
4,772,871 A	9/1988	Suzuki et al.	.....	341/155

5,030,954 A	7/1991	Ribner .....	341/172
5,144,308 A	9/1992	Norsworthy .....	341/131
5,203,335 A *	4/1993	Noujaim et al. .....	600/447
5,241,310 A	8/1993	Tiemann .....	341/143
5,446,917 A	8/1995	Krisciunas et al. .....	395/800
5,461,389 A	10/1995	Dean .....	342/154
5,477,859 A	12/1995	Engeler .....	128/661.01
5,521,499 A	5/1996	Goldenberg .....	327/237
5,565,867 A *	10/1996	Tiemann .....	341/143
5,668,777 A	9/1997	Schneider .....	367/96
6,208,189 B1 *	3/2001	Freeman et al. .....	327/277
6,252,531 B1 *	6/2001	Gordon et al. .....	341/143
6,366,227 B1 *	4/2002	Rigby .....	341/143

**FOREIGN PATENT DOCUMENTS**

JP 62-224345 10/1987 ..... A61B/17/36

**OTHER PUBLICATIONS**

Norman, O., *A Band-Pass Delta-Sigma Modulator for Ultrasound Imaging at 160 MHz Clock Rate*, 31(12) IEEE Journal of Solid-State Circuits 2036-41 (Dec., 1996).  
Baseri,R., et al., *Testing Adaptive Jamming Cancellation Algorithms Using a Digital Beamforming Array*, Proceedings of the 1997 IEEE National Radar Conference (May 13-15, 1997).

\* cited by examiner

*Primary Examiner*—Michael Tokar

*Assistant Examiner*—Lam T. Mai

(74) **Attorney, Agent, or Firm**—Welsh & Katz, Ltd.

(57) **ABSTRACT**

A method and apparatus are provided for reducing distortion in a dynamically delayed digital sample stream of an imaging system. The method includes the steps of delta-sigma modulating an input analog signal of the imaging system at a frequency above the Nyquist frequency of the input analog signal to generate a digital sample stream and changing a length of the sample stream to delay a portion of the sample stream while maintaining synchronism between a delta-sigma modulator and a demodulator of the system.

36 Claims, 27 Drawing Sheets

